Exploration Capabilities

Logistics Reduction and Repurposing Project (LRR)

Completed Technology Project (2011 - 2014)

Project Introduction

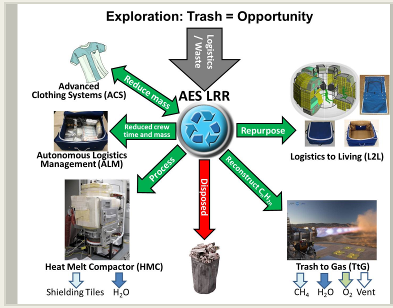
The project enables a largely mission-independent, cradle-to-grave-to-cradle approach to minimize logistics contributions to total mission architecture mass. The goals are to engineer logistics materials, common crew consumables, and container configurations to meet five basic goals. When these five goals are integrated across a mission, they will reduce ISS-equivalent packaging volume by 50%.

The Logistics Reduction Project is the follow-on to this project.

The Advanced Exploration Systems (AES) Logistics Reduction and Repurposing (LRR) project will enable a mission-independent cradle-to-grave-to-cradle approach to minimize logistics contributions to total mission architecture mass. The goals of LRR are to systematically engineer common crew consumables, container configurations, and waste management to meet five basic goals:

1. Direct reduction of logistical mass.
2. Improved automated tracking of logistical items in packaging containers and cabin environments to allow denser logistical packaging at launch and to save on-orbit crew time.
3. Direct reusing and repurposing of logistical items to avoid flying separate items to meet both functions.
4. Reprocessing of logistical items to provide a secondary function, increase habitable volume, and enhance life support closure.
5. Deconstruction of logistical materials and reconstruction to primary gases or as a means of reducing waste volume through venting.

The goals of the Logistics project will be accomplished through five hardware tasks plus a strong systems engineering analysis and integration function. The five hardware oriented tasks are:



LRR Turns Trash from Problem to Opportunity

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1. Use of an Advanced Clothing System (ACS) to directly reduce the mass and volume of clothing needed to be flown. Antimicrobial treatments are applied to current and lighter weight commercial-off-the-shelf (COTS) exercise clothing to investigate if they could be used for longer periods of time. Longer wear clothing will change the break-even point for laundering (vs. clothing disposal) sufficiently to delay development until Mars surface missions are planned.
2. Use of Autonomous Logistics Management (ALM) methods using radio frequency identification (RFID) technologies and 3D localization and complex event processing to enable automatic inventory tracking as resources move around a vehicle. ALM will reduce crew time in locating stored items in densely packed areas and enable the location of lost items.
3. Repurposing of logistics-to-living (L2L) multipurpose cargo transfer bags (MCTBs) for on-orbit outfitting. MCTBs can be used for constructing crew quarters, privacy or sound-adsorbing partitions, contingency water storage or waste water processing units, and dense-area RFID enclosures for ALM. Reuse of the MCTB logistics carriers prevents the need to fly separate items.
4. Conversion of waste and used logistical items to useable products with a heat melt compactor (HMC). Waste items are heated and mechanically compacted into stable tiles that can be used for radiation shielding. Additionally, water is recovered for life support processing. For a one-year mission, it is estimated that HMC could recover ~10 cubic meters of habitable volume, produce over 800 kg of radiation shielding tiles, and recover 230-720 kg of water.
5. Reformulation of trash to gas (TtG) to make propellant from waste products. Thermochemical processes are used to deconstruct trash to its hydrocarbon constituents and recombine it to form methane and other gases useful for propellant or life support. For a one year mission, it is estimated that TtG could produce up to 1500 kg of methane from trash.

Anticipated Benefits

All human space missions, regardless of destination, require significant logistical mass and volume that is strongly proportional to mission duration. As exploration missions lengthen in distance and duration, reduction of these logistics requirements becomes even more important since they may all have to be loaded on a single launch vehicle. This project works to reduce initial mass and volume of supplies or reuse items that have been launched.

These technologies may have broad use for potential commercial providers of future exploration systems, providing benefits for reduction of logistics requirements.

Organizational Responsibility

Responsible Mission Directorate:

Exploration Systems Development Mission Directorate (ESDMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Exploration Capabilities

Project Management

Program Director:

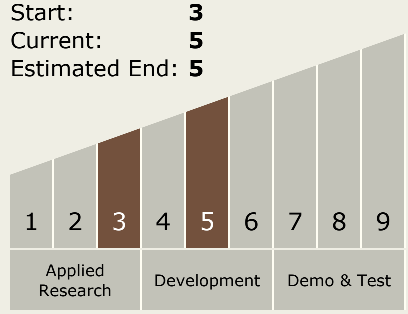
Christopher L Moore

Project Manager:

James L Broyan

Technology Maturity (TRL)

Start: **3**
Current: **5**
Estimated End: **5**



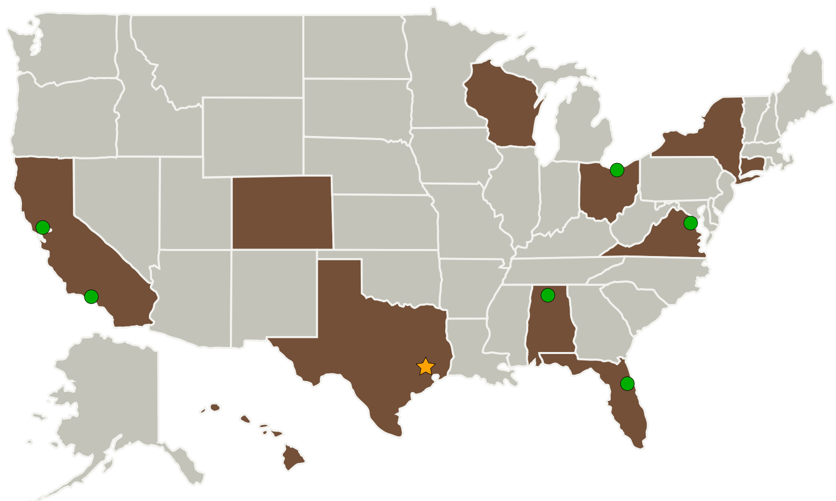
Technology Areas

Primary:

Continued on following page.

Technologies developed under this project could also be utilized by other government agencies whose personnel live and work in extreme remote environments, such as the military, the National Science Foundation research stations, etc.

Primary U.S. Work Locations and Key Partners



Technology Areas *(cont.)*

- TX07 Exploration Destination Systems
  - └ TX07.2 Mission Infrastructure, Sustainability, and Supportability
    - └ TX07.2.1 Logistics Management

Organizations Performing Work	Role	Type	Location
Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
Advanced Fuel Research, Inc.	Supporting Organization	Industry	East Hartford, Connecticut
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California
Cleveland State University	Supporting Organization	Academia	Cleveland, Ohio
Cornell University	Supporting Organization	Academia	Ithaca, New York
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California
Kennedy Space Center(KSC)	Supporting Organization	NASA Center	Kennedy Space Center, Florida
Manhattan College	Supporting Organization	Academia	Riverdale, New York
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama
NASA Headquarters(HQ)	Supporting Organization	NASA Center	Washington, District of Columbia
Orbital Technologies Corporation	Supporting Organization	Industry Women-Owned Small Business (WOSB)	Madison, Wisconsin
Pioneer Astronautics	Supporting Organization	Industry Historically Underutilized Business Zones (HUBZones)	Lakewood, Colorado

Continued on following page.

Organizations Performing Work	Role	Type	Location
Precision Combustion, Inc.	Supporting Organization	Industry	North Haven, Connecticut
TDA Research, Inc.	Supporting Organization	Industry	Wheat Ridge, Colorado
United Technologies Aerospace Systems	Supporting Organization	Industry	
University of Alabama in Huntsville(UAH)	Supporting Organization	Academia	Huntsville, Alabama
University of Hawaii Maui College	Supporting Organization	Academia	Kahului, Hawaii

Primary U.S. Work Locations	
Alabama	California
Colorado	Connecticut
District of Columbia	Florida
Hawaii	New York
Ohio	Texas
Virginia	Wisconsin

Project Transitions

October 2011: Project Start

September 2014: Closed out

Closeout Summary: To request closeout information for this project, please send an email with the Subject "TechPort Closeout Report Request" to hq-aes@mail.nasa.gov and specify which project closeout report you are requesting.

Images

Heat Melt Compactor Makes Stable Tiles from Trash
Heat Melt Compactor Makes Stable Tiles from Trash
(https://techport.nasa.gov/image/2772)

LRR Turns Trash from Problem to Opportunity
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